

WHAT IS CLAIMED IS:

1 1. A laser surgery system for treating a tissue located at a site of an
2 eye, the system comprising:
3 a laser making a beam of a treatment light energy, the treatment light
4 energy being deliverable to the site;
5 an imaging system forming an image of a natural tissue structure, the
6 natural tissue structure being in proximity to the site, the image of the site being visible to
7 the user;
8 a detector having the image of the structure formed thereon and generating
9 a first electrical signal in response to the image of the structure, the first signal being
10 related to a position of the structure; and
11 a processor adapted to generate a second electrical signal in response to the
12 first electrical signal, the second signal stabilizing the beam of treatment light energy
13 delivered to the tissue treatment site as the light energy is delivered to the tissue treatment
14 site.

1 2. The system of claim 1 wherein the imaging system forms a real
2 time image of the tissue treatment site, and the second signal stabilizes the real time
3 image of the tissue treatment site as seen by the user.

1 3. The system of claim 1 wherein the tissue treatment site corresponds
2 to a corneal tissue site of the eye, and the structure corresponds to a limbal structure of the
3 eye.

1 4. The system of claim 1 wherein at least one processor comprises a
2 computer program adapted to control a delivery of the light energy to the tissue treatment
3 site in response to at least one action of the user.

1 5. The system of claim 1 wherein the processor comprises a central
2 processing unit and a computer program adapted to determine the position of the
3 structure.

1 6. The system of claim 1 wherein the processor comprises an analog
2 circuit measuring a position of the structure.

1 7. The system of claim 2 further comprising a display visible to the
2 user, the display showing the stabilized real time image of the site.

1 8. The system of claim 7 wherein the image of the site is formed on a
2 camera, the camera being electronically coupled to the display.

1 9. The system of claim 1 wherein the optical system further comprises
2 a movable mirror, and the movable mirror moves in response to the second signal.

1 10. The system of claim 1 further comprising:
2 optical path means for receiving the laser beam, for aiming the beam at a
3 position in X-Y directions transverse to the beam, and for focusing the beam at a distance
4 in a Z direction as desired toward the tissue treatment site;
5 beam steering means connected to the optical path means for controlling
6 the position at which the beam is aimed in X-Y directions;
7 beam focusing means connected to the optical path means for controlling
8 the distance at which the laser beam is focused;
9 tracking means for tracking eye movements during the progress of the
10 surgery, including X-Y tracking means for tracking the structure of the eye in X and Y
11 directions, and Z tracking means for tracking movements of the eye in the Z direction
12 toward and away from the system; and
13 safety interrupt means for interrupting delivery of the laser beam to the
14 patient when it is determined that the tracking means has lost the structure being tracked.

1 11. A method of treating a tissue located at a site of an eye of a patient
2 with a laser, the tissue treatment site being seen by a user, the method comprising:
3 making a beam of a treatment light energy with the laser, the treatment
4 light energy being deliverable to the tissue treatment site;
5 forming a real-time image of the tissue treatment site and an image of a
6 natural tissue structure with an optical system, the natural tissue structure being in
7 proximity to the tissue treatment site;
8 measuring a position of the tissue structure from a first electrical signal
9 generated by a detector, the detector having the image of the structure formed thereon, the
10 first signal being related to the position of the structure;

11 generating a second electrical signal in response to the measured position
12 of the structure, the second signal stabilizing the beam of treatment light energy as the
13 treatment light energy is delivered to the tissue treatment site; and
14 transmitting the stabilized beam of treatment light energy to the tissue
15 treatment site.

1 12. The method of claim 11 further comprising stabilizing a real time
2 image of the tissue treatment site as seen by the user while the treatment light energy is
3 delivered to the tissue treatment site.

1 13. The method of claim 12 further comprising moving a mirror in
2 response to the second signal to stabilize the real-time image of the site as seen by the
3 user.

1 14. The method of claim 11 further comprising ablating a surface of a
2 cornea of the eye by pulsing the laser.

1 15. The method of claim 11 further comprising:
2 receiving the beam with an optical delivery system;
3 aiming the beam at a position in X-Y directions transverse to the beam
4 with the optical delivery system, the optical delivery system comprising a beam steering
5 optic;
6 focusing the beam in a Z direction at a distance with the optical delivery
7 system, the optical delivery system comprising a front lens element;
8 controlling the position at which the beam is aimed in X-Y directions
9 using the beam steering optic of the optical delivery system;
10 controlling the distance at which the laser beam is focused in the Z
11 direction with the beam focusing optic of the optical delivery system;
12 tracking eye movements of the patient during the progress of the surgery
13 by tracking eye movements in X and Y directions with the detector and by tracking eye
14 movements in a Z direction with a second optical detector;
15 automatically shifting the beam steering optic and the beam focusing optic
16 with a processor as the eye is tracked through X, Y and Z directions to change the
17 position of the laser beam and the distance at which the laser beam is focused so as to
18 follow movements of the eye; and

19 automatically interrupting delivery of the laser beam to the tissue treatment
20 site when it is determined via the processor that the sensor has lost the structure being
21 tracked.